# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-037329
(43)Date of publication of application : 12.02.1999

(51)Int.Cl. F16K 25/00
F16K 7/12
F16K 7/17
F16K 27/00

(21)Application number : 09-211182
(22)Date of filing : 23.07.1997

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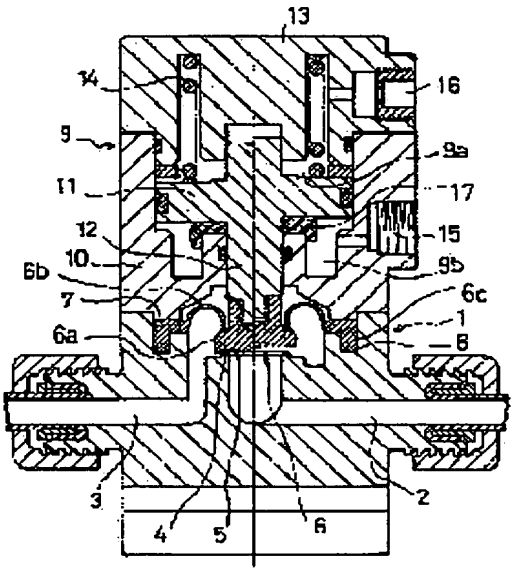
## (54) RESIN DIAPHRAGM VALVE

(57)Abstract:
PROBLEM TO BE SOLVED: To inhibit the generation of particles every opening and closing operation of a valve.
SOLUTION: In a diaphragm valve where a diaphragm 6 is pressed to a valve seat face of a valve casing 1 for cutting off the liquid flowing inside the valve casing, at least the valve casing 1 is a PFA molding, and the diaphragm comprises a central valve element 6a, a circular thin film part 6b integrally formed around the valve element, and a cylindrical holding part 6c integrally formed around the circular thin film part. Further the circular thin film part 6b is curved in such manner that a section thereof has an upward spherical shape, a root part of an inner periphery thereof is almost vertically connected to an upper face of the valve element 6a, a root part of an outer periphery thereof, is almost vertically connected to an upper edge of the inner peripheral face of the cylindrical holding part 6c, and a rubber 17 for damper is fitted to an outer periphery of a piston rod 12 of a cylinder 9 of a valve driving part for pressing the diaphragm 6 to a valve seat, to be held between the piston 11 and a cylinder case 10.




LEGAL STATUS

[Date of request for examination] 01.04.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

* NOTICES *



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CLAIMS

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[Claim(s)]
[Claim 1] In the diaphragm valve which intercepts the liquid which presses diaphram against the valve seat side of a valve box, and flows the interior of a valve box, a valve box is made with PFA mold goods at least. Said diaphram A central valve element, While being constituted by the annular thin film section formed in the perimeter of the valve element at one, and the tubed attaching part formed in the perimeter of the annular thin film section at one Said annular thin film section is curved in the shape of the cross-section facing-up spherical surface, and the root section of inner circumference is connected almost at right angles to the top face of said valve element. Connect almost at right angles to the inner skin upper limb of said tubed attaching part, and the root section of a periphery changes. The diaphragm valve made of resin characterized by fitting the rubber for absorbers in the periphery of the piston rod of the cylinder of the valve mechanical component which presses this diaphram against a valve seat, intervening between a piston and a cylinder case, and changing.
[Claim 2] The diaphragm valve made of resin characterized by making the outer diameter of the valve element of the center of diaphram greatly corresponding to this in the diaphragm valve made of resin according to claim 1 while the aperture of a valve seat is made greatly.
[Claim 3] The diaphragm valve made of resin characterized by the aperture of the orifice for the Ayr supply to the bottom room of a cylinder which has rubber for absorbers being made by 0.1-0.5mm in the diaphragm valve made of resin according to claim 1 or 2.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the diaphragm valve made of resin used for supply of pure water or a drug solution at wet stations, such as a washing station of a silicon wafer, and an etching system, in semiconductor fabrication machines and equipment.
[0002]
[Description of the Prior Art] If drawing 5 explains an example of the diaphragm valve made of resin of the conventional above-mentioned application, 1 is a valve box and the fluid outflow path 3 is established in the 1 side at the side the fluid inflow path 2 and else. Opening is carried out to the core in a valve box 1, the opening periphery is extended, projection 4 is formed, and the outlet side of the fluid inflow path 2 serves as the valve seat 5 of the shape of cross-section radii with the small tip of the projection 4. 6 is diaphram, it has valve element 6a stuck to a valve seat 5 by pressure in the center, has annular thin film section 6b formed in the perimeter of a lower limit of the valve element 6a at one, and has tubed attaching part 6c formed in the perimeter of the annular thin film section 6b at one. 7 is the diaphram presser foot which presses down tubed attaching part 6c of the diaphram 6 attached in the slot 8 of the perimeter in a valve box 1, this diaphram presser foot 7 is formed in the lower limit side of the case 10 of the cylinder 9 of a valve mechanical component at one, and press immobilization is carried out into the tubed attaching part 6c fang furrow 8 by having bound the case 10 tight to the opening upper limit of a valve box 1, and having fixed. Valve element 6a of the center of diaphram 6 is combined with the rod 12 of a piston 11, a spring 14 is inserted in cylinder top room 9a between a piston 11 and cap 13, and the piston 11 is energized caudad. 15 is the Ayr feed hopper to bottom room of cylinder 9 9b, and 16 is the Ayr free passage opening of cylinder 9 top room 9a and the exterior.
[0003] Thus, if Ayr is supplied to bottom room of cylinder 9 9b, the constituted diaphragm valve If resist a spring 14 and a piston 11 goes up, valve element 6a of the center of the diaphram 6 combined with the rod 12 is isolated, and is opened from a valve seat 5 and Ayr is extracted from bottom room of cylinder 9 9b A piston 11 is energized with a spring 14, it descends, and valve element 6a of the center of the diaphram 6 combined with the rod 12 is stuck to a valve seat 5 by pressure.
[0004] By the way, a valve box 1 is a product made from PTFE, and the diaphram 6 of the above-mentioned conventional diaphragm valve is a product made from PTFE in consideration of chemical resistance. For this reason, when valve element 6a of the center of diaphram 6 was stuck to a valve seat 5 by pressure at the time of clausilium, it became the beat of resin, and generating of particle was not avoided, but the yield was affected in the semi-conductor manufacture field. Moreover, it became that the bending test of the root section of the inner circumference of annular thin film section 6b carried out by vertical movement of valve element 6a, and bending stress concentrated on this part, especially, the root section of the inner circumference of annular thin film section 6b came to be pulled, it was easy to milk from the initial state, and there was a flume problem to which endurance falls in the top dead center of valve element 6a. furthermore -- an impact [ as opposed to / the above-mentioned conventional diaphragm valve has the large acceleration of the piston 11 by the valve-closing time and the spring 14, and thrust increases, and / the valve seat 5 of valve element 6a ] is mighty -- becoming -- therefore, wear and micron order -- minute ********** overly arises and generating of particle increases. For this reason, although inserting a damper spring in the bottom room of a cylinder 8 is performed in order to ease the impact over the valve seat 5 of valve element 6a of a valve-closing time, piston speed cannot be decreased, and an impact is still great and cannot decrease generating of particle. Although the valve box 1 of the above-mentioned conventional diaphragm valve is a product made from PTFE, since this valve box 1 is made from cutting, foreign matters,

such as weld flash, have adhered and generating of particle is not avoided further again.
[0005] on the other hand -- progress of high integration of recently and a semi-conductor -- following -- increasingly -- particle -- the diaphragm valve made of resin which the wet station of the free washing station for LS1 manufacture or an etching system is required, and is used for this -- particle -- a free thing comes to be required and it cannot respond in the diaphragm valve made of resin which particle generates as mentioned above at every valve-opening close actuation.
[0006]
[Problem(s) to be Solved by the Invention] Then, this invention tends to offer the diaphragm valve made of resin which enabled it to control that particle occurs at every valve-opening close actuation.
[0007]
[Means for Solving the Problem] The diaphragm valve made of resin of this invention for solving the above-mentioned technical problem In the diaphragm valve which intercepts the liquid which presses diaphram against the valve seat side of a valve box, and flows the interior of a valve box, a valve box is made with PFA mold goods at least. Said diaphram A central valve element, While being constituted by the annular thin film section formed in the perimeter of the valve element at one, and the tubed attaching part formed in the perimeter of the annular thin film section at one Said annular thin film section is curved in the shape of the cross-section facing-up spherical surface, and the root section of inner circumference is connected almost at right angles to the top face of said valve element. Connect almost at right angles to the inner skin upper limb of said tubed attaching part, and the root section of a periphery changes. It is characterized by fitting the rubber for absorbers in the periphery of the piston rod of the cylinder of the valve mechanical component which presses this diaphram against a valve seat, intervening between a piston and a cylinder case, and changing.
[0008] In the above-mentioned diaphragm valve made of resin, while the aperture of a valve seat is made greatly, it is desirable that the outer diameter of the valve element of the center of diaphram is greatly made corresponding to this.
[0009] Moreover, in each above-mentioned diaphragm valve made of resin, it is desirable that the aperture of the orifice for the Ayr supply to the bottom room of a cylinder which has rubber for absorbers is made by 0.1-0.5mm.
[0010]
[Embodiment of the Invention] Drawing 1 explains 1 operation gestalt of the diaphragm valve made of resin of this invention. A left half part shows a valve-closing condition, as for drawing 1 , a right half part shows a valve-opening condition, 1 is the valve box of PFA mold goods, and the fluid outflow path 3 is established in the 1 side at the side the fluid inflow path 2 and else. Opening is carried out at right angles to the core in a valve box 1, the opening periphery is extended, projection 4 is formed, and the outlet side of the fluid inflow path 2 serves as the valve seat 5 of the shape of cross-section radii with the small tip of the projection 4. 6 is the diaphram pressed against a valve seat 5, as shown in drawing 2 , it has in the center valve element 6a stuck to a valve seat 5 by pressure, has annular thin film section 6b formed in the perimeter of the valve element 6a at one, and has tubed attaching part 6c formed in the perimeter of the annular thin film section 6b at one. Said annular thin film section 6b is curved in the shape of the cross-section facing-up spherical surface, as shown in drawing 2 , and root section 6b' of inner circumference is connected almost at right angles to the top face of said valve element 6a, and root section 6b" of a periphery is connected almost at right angles to the inner skin upper limb of said tubed attaching part 6c. In drawing 1 , 7 is the diaphram presser foot which presses down tubed attaching part 6c of the diaphram 6 attached in the slot 8 of the perimeter in a valve box 1, this diaphram presser foot 7 is formed in the lower limit side of the case 10 of the cylinder 9 of a valve mechanical component at one, and press immobilization is carried out into the tubed attaching part 6c fang furrow 8 by having bound the case 10 tight to the opening upper limit of a valve box 1, and having fixed. Valve element 6a of the center of diaphram 6 is combined with the rod 12 of a piston 11, a spring 14 is inserted in cylinder top room 9a between a piston 11 and cap 13, and the piston 11 is energized caudad. 15 is the Ayr feed hopper to the bottom room of a cylinder 9, and 16 is the Ayr free passage opening of cylinder 9 top room 9a and the exterior. The rubber 17 for absorbers is fitted in the periphery of the piston rod 12 of the cylinder 9 of the valve mechanical component which presses said diaphram 6 against a valve seat 5, and it intervenes between the piston 11 and the cylinder case 10.
[0011] Next, drawing 3 explains other operation gestalten of the diaphragm valve made of resin of this invention. In the diaphragm valve of the above-mentioned operation gestalt, while the aperture of a valve seat 5 is made greatly, corresponding to this, as for the diaphragm valve of this operation gestalt, the outer diameter of valve element 6a of the center of diaphram 6 is made greatly.

[0012] Subsequently, drawing 4 explains the operation gestalt of further others of the diaphragm valve made of resin of this invention. Aperture of the orifice 18 of the Ayr feed hopper 15 to bottom room of cylinder 9 in which diaphragm valve of this operation gestalt has rubber 17 for absorbers in drawing 1 or diaphragm valve made of resin of drawing 3 9b is minimum-ized by 0.1-0.5mm.
[0013] Thus, it is a normal close type, and as shown in the left half part of drawing 1 R> 1, drawing 3 , and drawing 4 , a piston 11 is usually caudad energized with the spring 14 inserted in cylinder 9 top room 9a, valve element 6a of the center of the diaphram 6 combined with the rod 12 is stuck to a valve seat 5 by pressure, and clausilium of the diaphragm valve made of resin of each constituted operation gestalt is carried out. If Ayr is supplied to bottom room of cylinder 9 9b, as shown in the right half part of drawing 1 , drawing 3 , and drawing 4 , a spring 14 is resisted, a piston 11 goes up, and from a valve seat 5, valve element 6a of the center of the diaphram 6 combined with the rod 12 will be isolated, and will be opened.
[0014] Since a valve box 1 consists of PFA mold goods, each above-mentioned diaphragm valve made of resin does not have adhesion of foreign matters, such as weld flash by cutting, like the valve box made from conventional PTFE, and generating of particle is avoided. Moreover, annular thin film section 6b deforms elastically each above-mentioned diaphragm valve made of resin only for the part curved in the shape of the spherical surface at the time of valve-opening close actuation, and root section 6b' of an inside-and-outside periphery and 6b" have maintained the perpendicular condition mostly, as shown in drawing 1 , drawing 3 , and drawing 4 . Therefore, bending stress is not produced, but root section 6b' and 6b" are not milked at all, and generating of particle is prevented. Furthermore, since the rubber 17 for absorbers is fitted in the periphery of the piston rod 12 of the cylinder 9 of a valve mechanical component and each above-mentioned diaphragm valve made of resin intervenes between the piston 11 and the cylinder 10, the piston 11 by the valve-closing time spring 14 is slowed down, an impact with the valve seat 5 of valve element 6a of diaphram 6 can weaken, a water hammer is controlled, and generating of the particle by the shock pressure from the whole system is made to decrease.
[0015] Since the outer diameter of valve element 6a of the center of diaphram 6 is greatly made corresponding to this while the aperture of a valve seat 5 is made further greatly, the diaphragm valve made of resin of drawing 3 can narrow the clearance between a valve seat and a valve element, securing a flow rate, and can reduce a piston impact. And since valve element 6a contacts a valve seat 5 before the rate of the valve-closing time piston 11 rises, impulse force can weaken.
[0016] Since the diaphragm valve made of resin of drawing 4 has micrified the aperture of the orifice of the Ayr feed hopper 15 to bottom room of cylinder 9 9b to 0.1-0.5mm further again, as a result of performing discharge of Ayr slowly from bottom room of cylinder 9 by descent of valve-closing time piston 11 9b, a piston impact decreases further. And as a result of performing slowly supply of Ayr to bottom room of cylinder 9 9b at the time of valve-opening, the climbing speed of a piston 11, i.e., the climbing speed of valve element 6a, is controlled, and the rapid flow of a fluid is eased and generating of particle is controlled.

[0017] As a concrete example of the diaphragm valve made of resin shown in drawing 4 of this invention On the periphery of the piston rod 12 with a diameter [ of the cylinder 9 of a valve mechanical component ] of 33mm, the bore of 9mm, Fit in the rubber 17 for absorbers with an outer diameter [ of 20mm ], and a thickness of 5mm, and it is made to intervene between a piston 11 and the cylinder case 10. The aperture of the orifice 18 of the Ayr feed hopper 15 to bottom room of cylinder 9 9b While minimum-izing from 1.0 oldmm to 0.3mm and expanding the diameter of the outer diameter of valve element 6a of the center of diaphram 6 from 14 oldmm to 18mm, the diameter of the aperture of the valve seat 5 corresponding to this is expanded to 15mm. The diaphragm valve made of resin which made the clearance between valve element 6a and a valve seat 5 narrow to 0.7mm from 2.5 oldmm, As an example of the conventional diaphragm valve made of resin shown in drawing 5 R> 5, there is no rubber for absorbers in the periphery of the piston rod 12 with a diameter of 9mm. The aperture of the orifice of the Ayr feed hopper 15 to bottom room of cylinder 9 9b by 1.0mm When the outer diameter of valve element 6a of the center of diaphram 6 measured the working speed of valve element 6a with the diaphragm valve made of resin whose clearance between 11mm, valve element 6a, and a valve seat 5 the aperture of the valve seat 5 corresponding to 14mm and this is 2.5mm, the result as shown in the following table 1 was obtained.
[0018]
[Table 1]

| | 開→閉 | 閉→開 |
|---|---|---|
| 実施例の樹脂製ダイヤフラム弁の弁体の動作速度 | 8．3mm/sec | 4．1mm/sec |
| 従来例の樹脂製ダイヤフラム弁の弁体の動作速度 | 48mm/sec | 16．6mm/sec |

[0019] Compared with the working speed of the valve element of the diaphragm valve made of resin of the conventional example, the working speed of the valve element of the diaphragm valve made of resin of an example decreases to 6 by about 1/in the open -> close, and is decreasing to one fourth in the close -> open so that clearly [ in the above-mentioned table 1 ]. That is, although the clearances (stroke) between valve seats are decreasing in number or less [ of the clearance (stroke) between the valve elements and valve seats in the conventional example ] to 1/3, as for the valve element in an example, it turns out that the working speed of a valve element is decreasing to 1 / 4 - 1/6, and the impulse force over the valve seat of a valve element is decreasing remarkably. Therefore, the soft landing of the valve element is made to a valve seat, and it is prevented that particle occurs at the time of valve-opening close.

[0020]

[Effect of the Invention] Since a valve box consists of PFA mold goods at least, the diaphragm valve made of resin of this invention does not have adhesion of foreign matters, such as weld flash by cutting, and generating of particle is avoided so that it may understand by the above explanation. Moreover, while the annular thin film section of diaphram deformed elastically only the part curved in the shape of the spherical surface at the time of valve-opening close actuation and the root section of an inside-and-outside periphery had maintained the perpendicular condition mostly, bending stress is not produced, but the root section does not milk and generating of particle is prevented. Since the rubber for absorbers furthermore intervenes between the piston of a valve mechanical component, and the cylinder case, an impact with the valve seat of the valve element of valve-closing time diaphram can weaken, a water hammer is controlled, and generating of the particle by the shock pressure from the whole system is made to decrease.

[0021] In the diaphragm valve made of resin of this invention, if it is in some which made the outer diameter of the valve element of the center of diaphram greatly corresponding to this while making the aperture of a valve seat greatly, the clearance between a valve seat and a valve element can be narrowed securing a flow rate, and a piston impact can be reduced.

[0022] Furthermore, in the diaphragm valve made of resin of this invention, if it is in some which micrified the aperture of the orifice of the Ayr feed hopper to the bottom room of a cylinder to 0.1-0.5mm Discharge of Ayr by descent of a valve-closing time piston becomes slow, a piston impact decreases further, at the time of valve-opening, supply of Ayr becomes slow, the climbing speed of a valve element is controlled, the rapid flow of a fluid is eased and generating of particle is controlled.

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DRAWINGS

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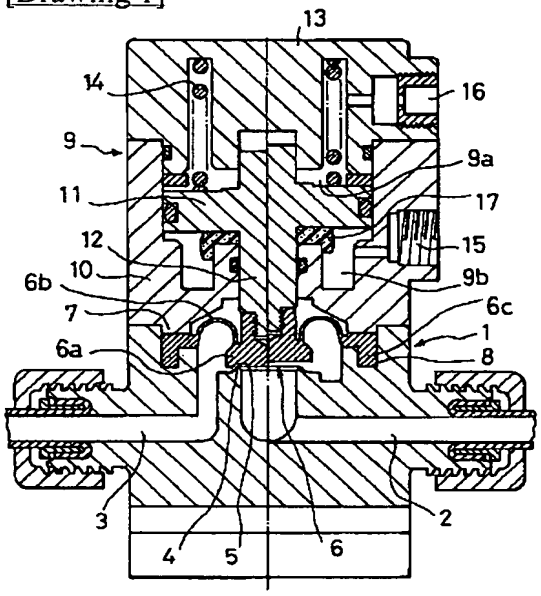
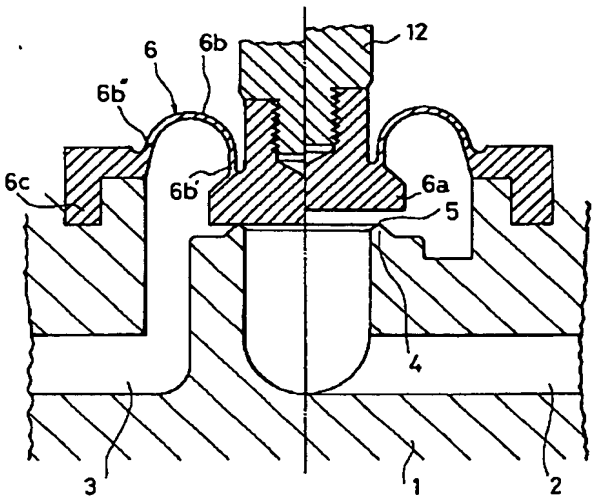
[Drawing 1]



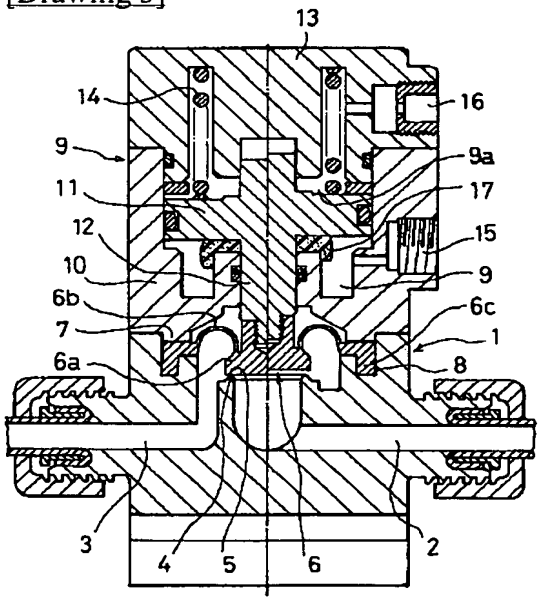

1… 弁箱
5… 弁座
6… ダイヤフラム
6a…弁体
6b…環状薄膜部
6c…筒状保持部
9 … シリンダー
10… シリンダーケース
11… ピストン
12… ピストンロッド
15… エアー供給口
17… ダンパー用ラバー

[Drawing 2]



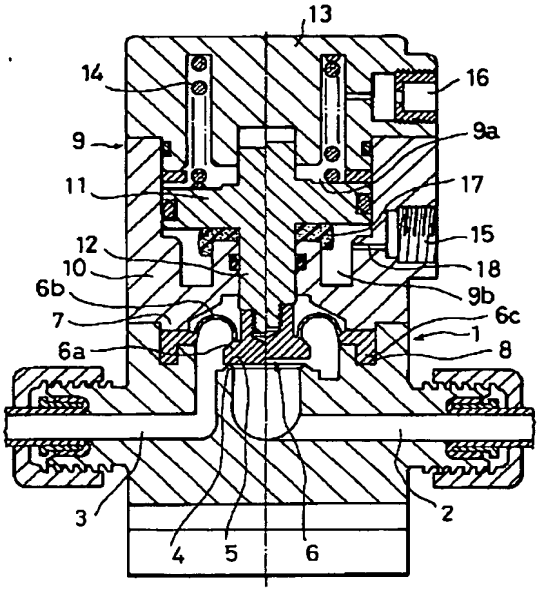

1… 弁箱
5… 弁座
6… ダイヤフラム
6a…弁体
6b…環状薄膜部
6b'…内周の付根部
6b"…外周の付根部
6c…筒状保持部
12…ピストンロッド

[Drawing 3]



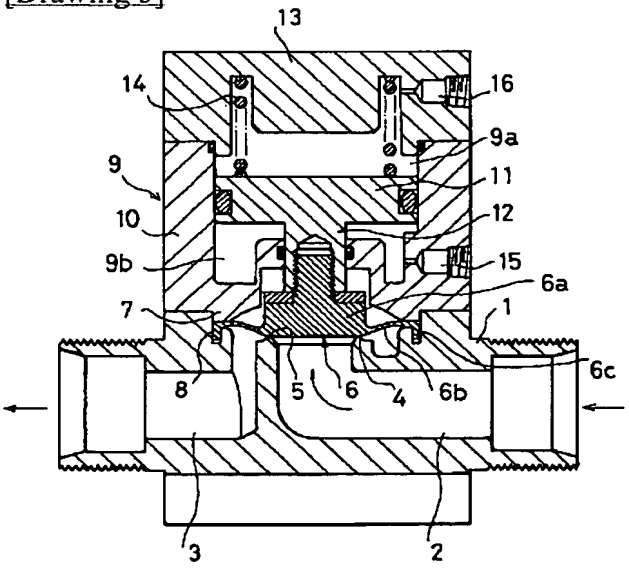

1… 弁箱
5… 弁座
6… ダイヤフラム
6a…弁体
6b…環状薄膜部
6c…筒状保持部
9… シリンダー
10… シリンダーケース
11… ピストン
12… ピストンロッド
15… エアー供給口
17… ダンパー用ラバー

[Drawing 4]




1… 弁箱
5… 弁座
6… ダイヤフラム
6a… 弁体
6b… 環状薄膜部
6c… 筒状保持部
9… シリンダー
10… シリンダーケース
11… ピストン
12… ピストンロッド
15… エアー供給口
17… ダンパー用ラバー
18… オリフィス

[Drawing 5]

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